



JUNE 28 - 30, 2005 NORFOLK CONVENTION CENTER

Representing Human Activities in DoD Architectures

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30 June 2005





Find The Human in This Unmanned System



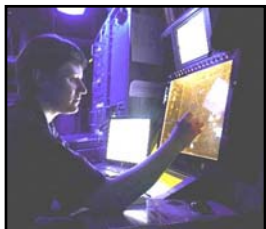
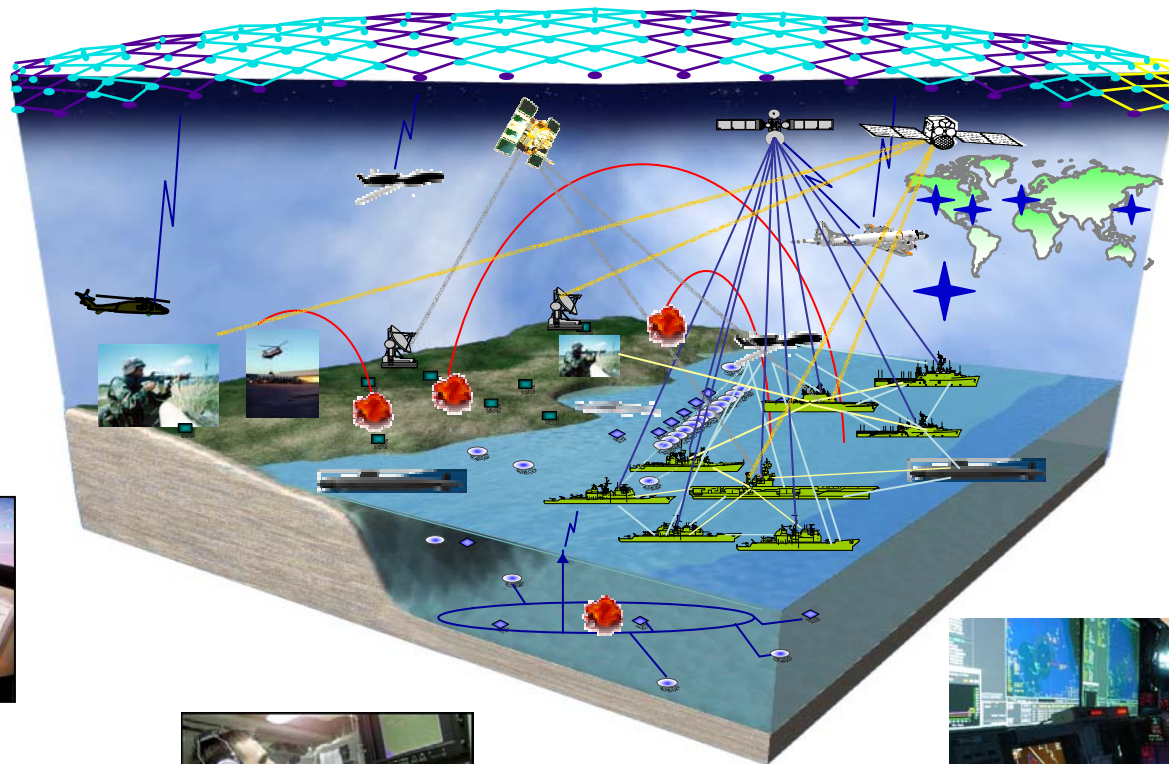
6/10/2005 - **LANGLEY AIR FORCE BASE, Va. (AFPN)** -- **Pilot error** caused the Nov. 24, 2004 crash of an MQ-1 Predator unmanned aerial vehicle at an undisclosed military installation in the U.S. Central Command area of responsibility, according to an accident investigation board report released June 10.



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Representing The Human In System Architectures



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Agenda



- Key Definitions
- Human Systems Integration (HSI) in DoD Architecture Framework (DoDAF) 1.0
- Incorporating HSI Into Selected DoDAF Products
- Potential Improvements in DoDAF 2.0



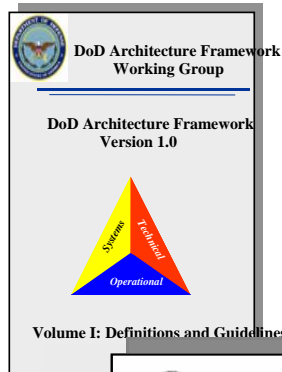
Key Definitions



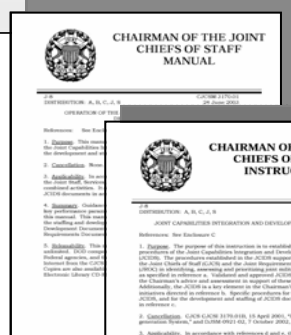
- System Function:
 - The action or work performed by a system or systems (hardware, and/or software) to support, aid or enable activities in satisfying operational mission requirements. System functions are described by verbs (e.g. sense, command, act) or action words or phrases. *Typically executed by HW / SW systems.*
- Operational Activity:
 - The operational work component(s) (a step accomplished) in a process needed to accomplish an operational mission or task. Operational activities are described as nouns. Activities are the things or steps that occur in a process (e.g. Find, fix, track, ID). *Executed by HW / SW, organizations or humans.*



DoD Architecture Framework

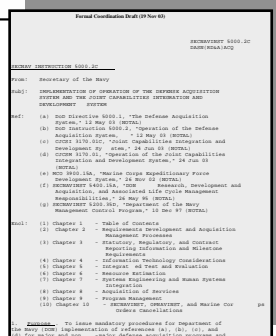


- ◆ DoD 5000.1 and DoD 5000.2
 - Establishes DoD acquisition policy
 - Requires select integrated architecture views at each milestone
 - Content and Scope of architecture products used is determined by MDA/PM
- ◆ DoD Architecture Framework Document
 - Provides basis for developing standardized architecture views and products required by DOD, CJCS, and SECNAV policy documents



- ◆ CJCSI 3170.01C
 - ◆ Requires the development of integrated architecture products for supporting acquisition documentations:
 - Joint Capability Integration and Development System (JCIDS)
 - Information Support Plans
 - Capability gap and redundancy analysis
- ◆ CJCSI 6212.01C
 - Requires architecture products be used in the J-6 interoperability and supportability certification process
 - Specifies which architecture products are required for the ICD, CDD, and CPD

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- ◆ SECNAV INST 5000.2C
 - Establishes DON acquisition policy
 - Directs the PEO/PM to develop mission integrated architectures in support of the CDD/CPD process
 - Directs ASN (RD&A) CHENG to assist the PMs in the development of architectural views.



HSI in DoDAF Version 1.0



- HSI Content in DoDAF 1.0
 - Volume I: Section 4.4, Human Factors
 - Describes the importance of including the role of humans in accomplishing military missions within a system.
 - Volume II: All sections
 - Provides detailed descriptions of architecture products and human role representation within each product
 - Volume III (Deskbook): Section 2.8, Representing the Role of Humans in Architectures
 - Introduces Human-Centered Architecture Supplements for OV-4 and OV-5, SV-4, SV-5
 - Provides insight about human behavioral processes to be considered
 - Provides notional examples for products

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Products



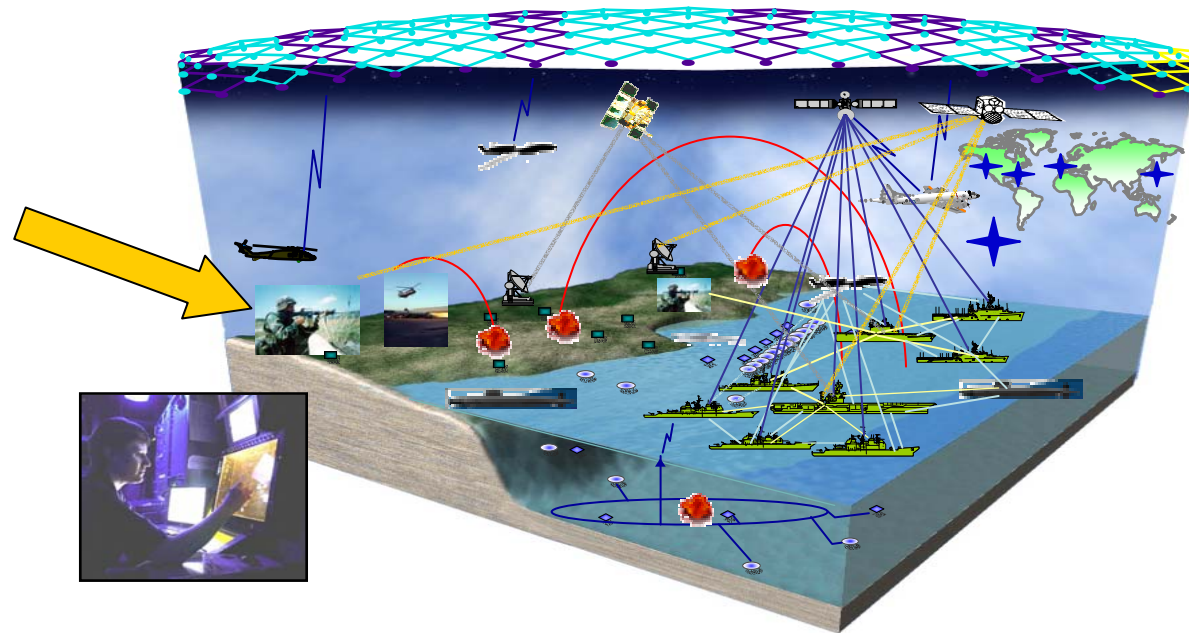
Applicable View	Framework Product	Product Name	General Description
All Views	AV-1	Overview and Summary Information	Scope, purpose, intended users, environment depicted, analytical findings
All Views	AV-2	Integrated Dictionary	Data repository with definitions of all terms used in all products
Operational	OV-1	High-Level Operational Concept Graphic	High-level graphical/ textual description of operational concept
Operational	OV-2	Operational Node Connectivity Description	Operational nodes, operational activities performed at each node, connectivity and information exchange needlines between nodes
Operational	OV-3	Operational Information Exchange Matrix	Information exchanged between nodes and the relevant attributes of that exchange
Operational	OV-4	Organizational Relationships Chart	Organizational, role, or other relationships among organizations
Operational	OV-5	Operational Activity Model	Operational Activities, relationships among activities, inputs and outputs. Overlays can show cost, performing nodes, or other pertinent information
Operational	OV-6c	Operational Event-Trace Description	One of three products used to describe operational activity sequence and timing - traces actions in a scenario or sequence of events and specifies timing of events
Systems	SV-4	Systems Functionality Description	Functions performed by systems and the system data flows among system functions
Systems	SV-5	Operational Activity to System Function Traceability Matrix	Mapping of systems back to capabilities or of system functions back to operational activities
Systems	SV-7	System Performance Parameter Matrix	Performance characteristics of systems view elements for the appropriate time frame(s)
Technical	TV-1	Technical Standards Profile	Extraction of standards that apply to the given architecture



OV-1 High-Level Operational Concept



- The operational concepts sets the stage for other architecture products and it serves as the primary high-level communication tool to describe the system to all stake holders.
- If the human plays a significant role in the system, it must be identified in the operational concept



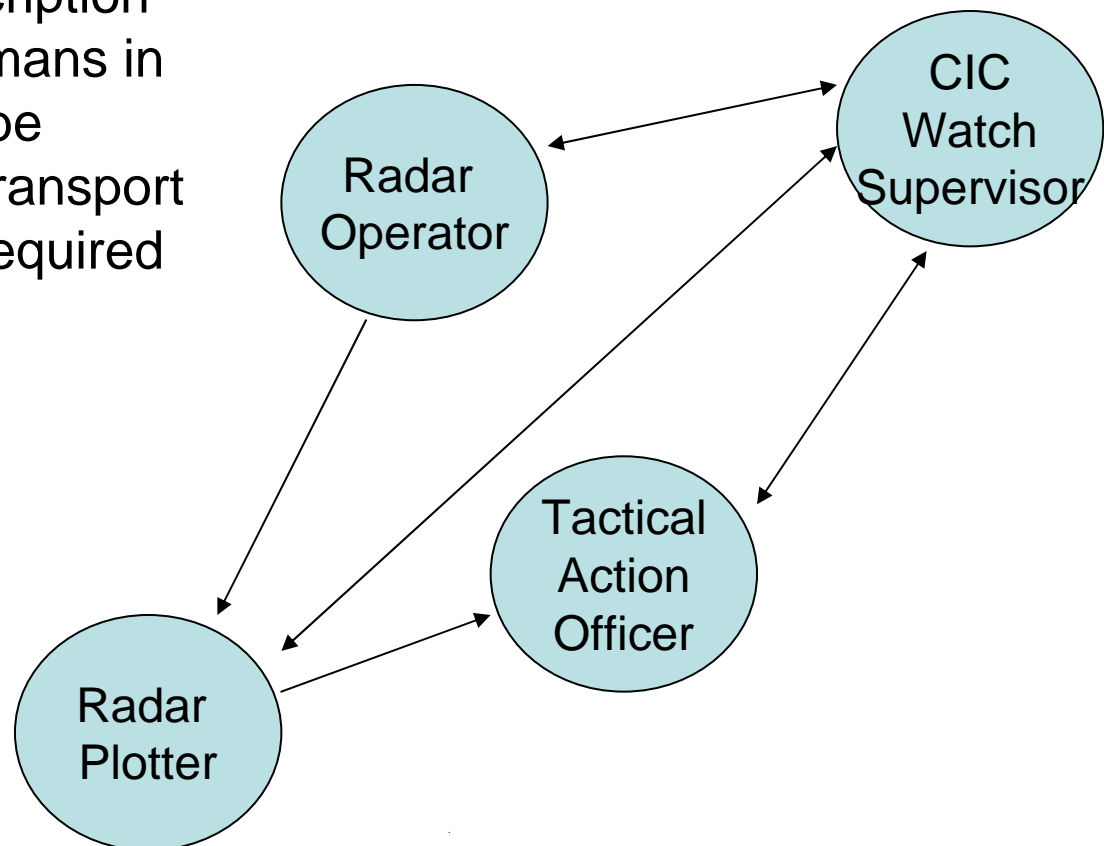
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OV-2 Operational Node Connectivity Description



- At lower levels of decomposition, the operational node connectivity description should identify key humans in the system and describe mechanisms for data transport and number of paths required





OV-3 Operational Information Exchange Matrix



- Information exchanges that require human intervention must be characterized to understand interface requirements (i.e. data transfer rate vs. processing time for human)

* Identifier/ Name of Operational Needline Supported (from OV-2)	* Identifier/ Name of Information Exchange	Performance Attributes			Information Assurance Attributes				Threats			Physical Environment			Remarks/ Other
		Frequency	* Timeliness	Throughput	* Security Classification (& Declassification/ Restrictions, if app.)	* Priority or Criticality	Integrity Checks Required	Assured Authorization to Send/ Receive	Physical (includes weather, terrain)	Electronic (jamming, hackers, etc.)	Political/ Economic	Aerospace	Land	Sea	
1	e.g., 1-a ⋮ 1-n														
2	e.g., 2-a ⋮ 2-n														
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
n															

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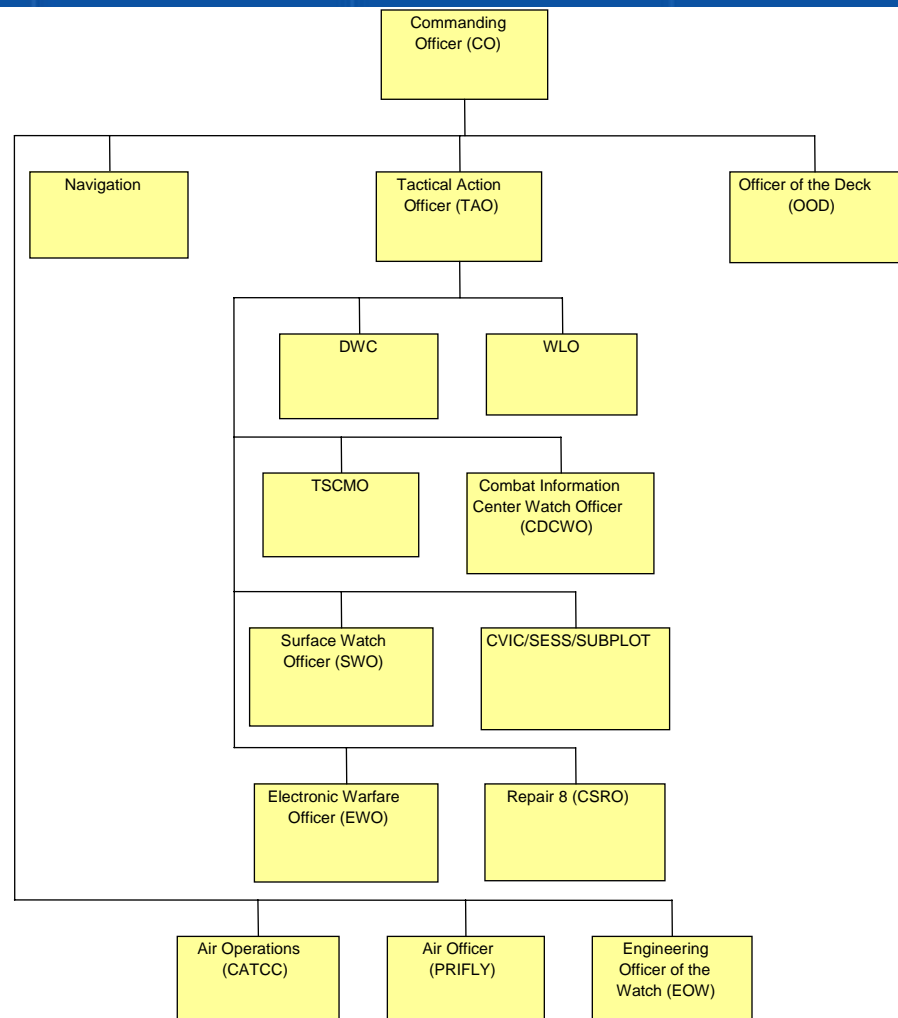
OV-4 Organizational Relationship Chart



- Identify the organization and the human within the organization who will be carrying out the operational activity. This level of detail can help to identify organizational support needed to accomplish the mission (e.g. skill set, training)
- The human architecture supplement to the OV-4 is “Human Roles and Responsibilities” which provides additional definition of the responsibility in tabulated form.

<u>Position</u>	<u>Responsibilities</u>
AADC	Provide theatre-wide are defense against ABT and TBM. Coordination between component commanders and task force commander. Design of air defense plan for theatre
RADC (Afloat)	Air defense for the region assigned. Coordinate the ADUs for the assigned region.
AW	Air defense for the battlegroup
TACAIR	Defense counter-air

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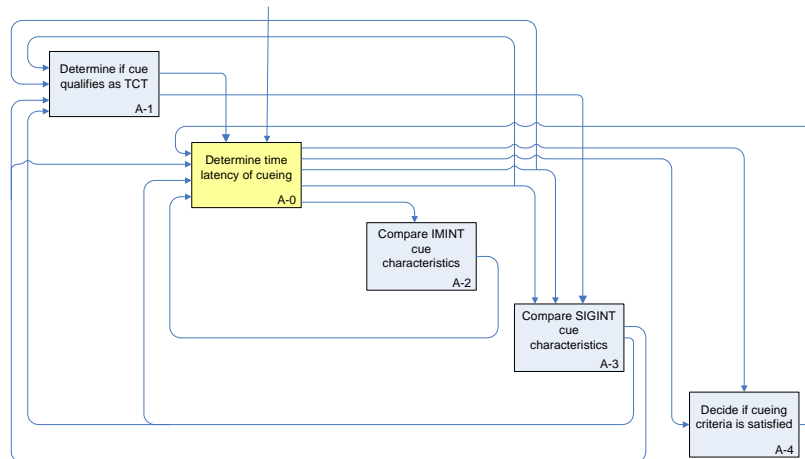




OV-5 Operational Activity Model



- Identifies what activities need to be performed by the system.
- The human supplement “Human Activity Model” can be used to relate activities (or tasks) to specific human nodes



TCT ACTIVITY	HUMAN FUNCTIONAL ACTIVITY	INFORMATION REQUIREMENTS	PROCESS	SPECIFIC BEHAVIOR
1.1 Assess ISR Cue				
1.1.1	Determine if cue qualifies as TCT	TCT list, Commander's guidance, ROE	Cognitive	Decides
1.1.2	Determine time latency of cueing by subtracting current time from time stamp of cue (Provides indication of likelihood that target is still in same location)	Current time, time stamp of cue.	Cognitive	Calculates
1.1.3	Compare IMINT cue characteristics against known IMINT data	IMINT characteristics, access to relevant data bases, TCT list	Cognitive	Compares
1.1.4	Compare SIGINT cue characteristics against known SIGINT data	SIGINT data, access to relevant data bases, TCT list	Cognitive	Compares
1.1.5	Decide if cueing criteria is satisfied	Cue content, Cueing criteria	Cognitive	Decides

**Notional examples*

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OV-5 Example – All Inclusive



Operational Activity Model (OV-5) Human Activities Supplement

Behavior Processes							
Perceptual							
Receiving Information						objects.	
Inspects	Observes	Reads	Monitors	Scans	Detects	Identifies	Locates

Level	IDEF0 Activity	Actor								
1	Perform Advanced Planning									
1.1	Provide for CBR Training									
1.1.1	Plan CBR Training									
1.1.1.1	Provide Training Direction and Coordination (1.1.1)									
1.1.1.1.1	<i>Direct and coordinate the training of ships crew and embarked personnel in CBR-D procedures.</i>	CO								
1.1.1.1.2	<i>Direct and coordinate the exercise and traing of ships personnel in CBR-D procedures.</i>	XO		1						
1.1.1.1.3	<i>In coordination with DCA, train personnel in Damage Control Matters</i>	Dept Heads,DCA						1		1
1.1.1.1.4	<i>Assign personnel to DC repair parties/teams and the CBR-D organization IAW Battle Bill</i>	CAG,DCA								
1.1.1.1.5	<i>Coordinate shipboard training with the DCA and air officer</i>	CAG,DCA								
1.1.1.1.6	<i>Coordinate ship's survivability matters, including the ship damage control training program</i>	DCA								

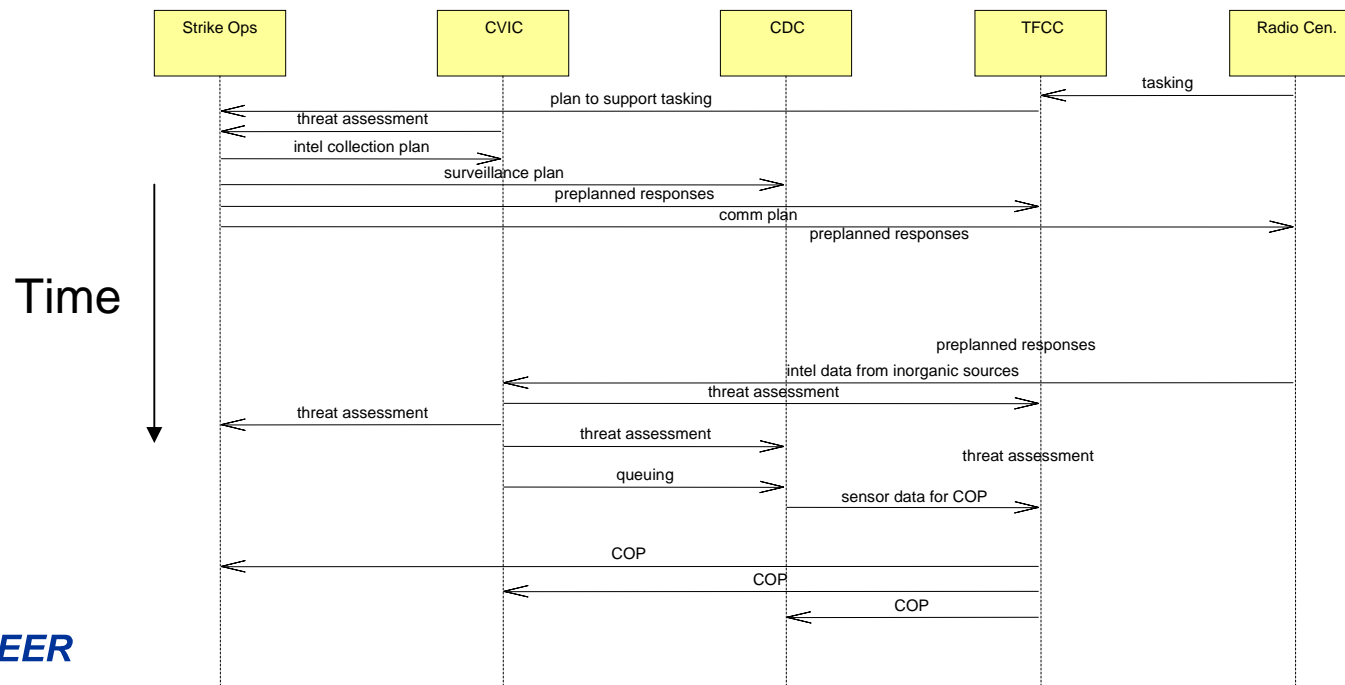
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OV-6c Operational Event-Trace Description



- Identifies node interactions over time, in response to a given event.
- Human roles can be described to evaluate response time.



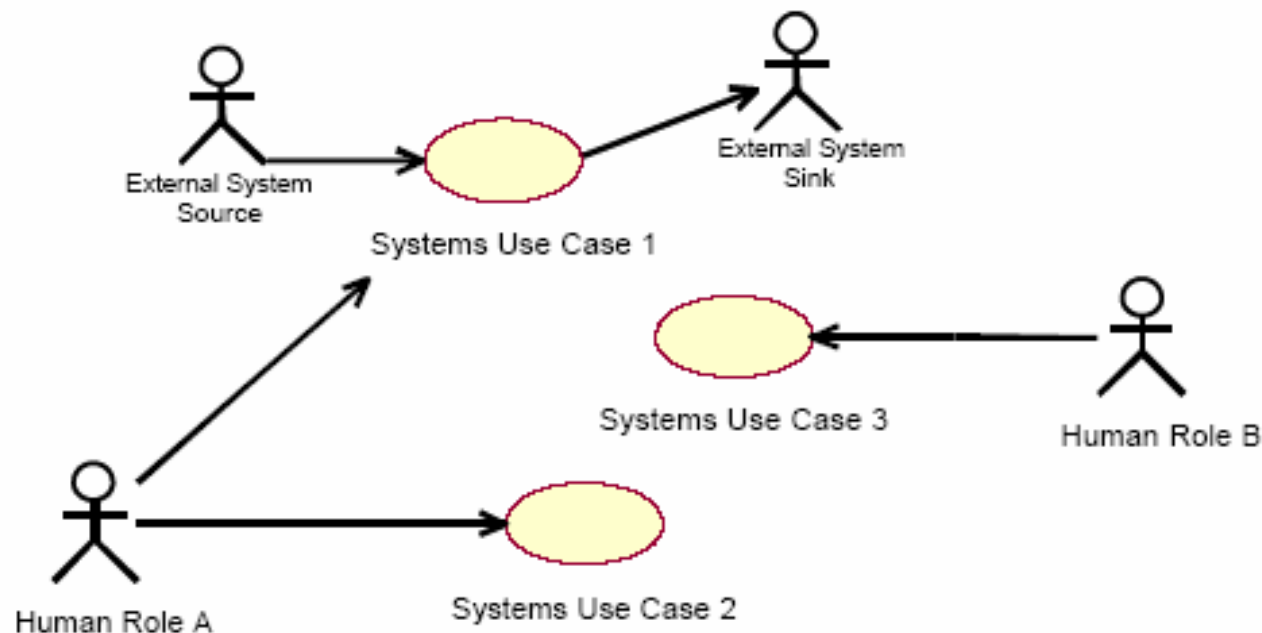
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SV-4 System Functionality Description



- Use the system functional description to include human interaction with system.
- Can be done via external “source” and “sink” features described in CADM, expand description using the human architecture supplement “System Function Allocation”



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Figure 5-16. UML Use Case Diagram for Systems Functionality Description (SV-4)



SV-4: Systems Functionality-Human Centered Supplement



Strike		System Functions																											
		SF#		System Functions - 3.0 (Act)													2.2.1	2.2.3	2.2.3.1	2.2.3.4	2.3	2.4	2.4.1	2.4.2	2.4.3	2.4.4.4	2.4.5.5	2.4.6	3.1.1
3.1	Engagement Execution																												
3.1.1	Direct Attack/Evasive Maneuvers																											X	
3.1.2	Determine Engageability																				X								
3.1.2.1	Develop Intercept Prediction																				X								
3.2	Target Development																												
3.2.1	Employ Targeting Assets		X																		X								
3.2.1.1	Task/Re-task Targeting Assets		X																		X								
3.2.1.1.1	Transmit Tasking and Target Data to Targeting Assets		X	X	X																X								
3.2.2	Designate Target																					X	X						
3.2.4.1	Determine Target Location				X		X														X	X	X						
HA#	Human Activities - 3.0 (Act)																												
3.1	Assess ISR Cue																												
3.1.1	Determine if cue qualifies as TCT		X																										
3.1.2	Determine time latency of cueing		X			X																							
3.1.3	Compare IMINT cue characteristics against known IMINT data			X																									
3.1.4	Compare SIGINT cue characteristics against known SIGINT data			X																									

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SV-5 Operational Activity to System Function Traceability Matrix



- Use the traceability matrix to map system function to specific human roles

Operational Activities

System Functions	3.11	3.11.3	3.12	3.12.1	3.12.2	3.12.3	3.13	3.14	3.14.1	3.14.2	3.14.3	3.14.4	3.15	3.16	3.17	3.17.1
1	X															
1.1		X														
1.1.1			X													
1.1.1.1	X															
1.1.1.2					X											
1.1.1.3							X									
1.1.2										X						
1.1.2.1				X												
1.1.2.2						X										
1.1.2.3								X								
1.1.3											X					
1.1.3.1													X			
1.1.3.2									X							
1.1.3.3														X		
1.1.3.4														X		

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Figure 5-22. Operational Activity to Systems Function Traceability Matrix (SV-5)



SV-5: Operational Activity to Systems Function Traceability Matrix - Human Centered Supplement

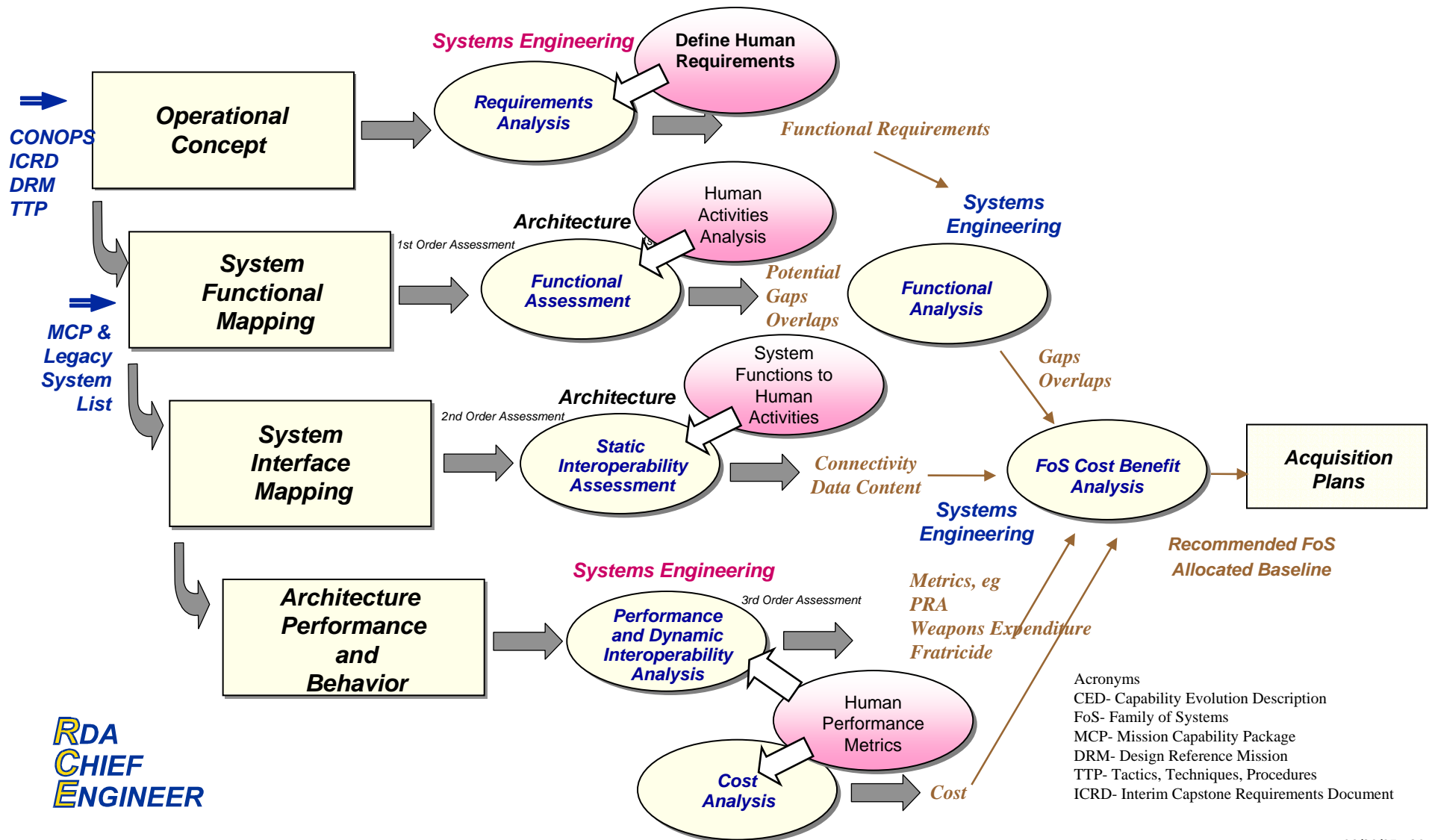


Strike		Operational Activities Assess															
		Collect				Exploit									Remove from Target List	Decide TCT Negation - Pair Weapon/Pltfrm/Snsr to Target	
SF#	System Functions - 3.0 (Act)	2.2.1	2.2.3	2.2.3.1	2.2.3.4	2.3	2.4	2.4.1	2.4.2	2.4.3	2.4.4.4	2.4.5.5	2.4.6	3.1.1	3.1.5	5.1.1.1	
3.1	Engagement Execution																
3.1.1	Direct Attack/Evasive Maneuvers													X		X	
3.1.2	Determine Engageability											X					
3.1.2.1	Develop Intercept Prediction											X					
3.2	Target Development																
3.2.1	Employ Targeting Assets	X										X					
3.2.1.1	Task/Re-task Targeting Assets	X										X					
3.2.1.1.1	Transmit Tasking and Target Data to Targeting Assets	X	X	X								X					
3.2.2	Designate Target												X	X			
3.2.4.1	Determine Target Location			X		X						X	X	X			
HA#	Human Activities - 3.0 (Act)																
3.1	Assess ISR Cue																
3.1.1	Determine if cue qualifies as TCT	X															
3.1.2	Determine time latency of cueing	X			X												
3.1.3	Compare IMINT cue characteristics against known IMINT data		X														
3.3.4	Compare SIGINT cue characteristics against known SIGINT data		X														

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Architecture-Based System Engineering Approach Is the Technical Underpinning



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Potential Improvements to Human Representation in DoDAF 2.0



- Improve [solidify] process
 - Include more examples of human roles for other products (e.g. OV-6c)
 - Provide examples of behaviors associated with human activities
 - Provide examples of metrics associated with above behaviors for cognitive workload, situational awareness, skill set
 - Demonstrate how architectures may be used for quantitative analysis related to execution of operational activities and impact of values to overall system performance

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Conclusion



- Effective system representation in architectures must include the human element
- ASN (RDA) CHENG has promoted inclusion of human elements in DoDAF
- Small investments aimed to include human factors at the beginning of the systems engineering process can save time and resources at later stages of life cycle
- New ideas are needed to achieve full integration of human considerations in the architecture development process

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Additional Information



BACK-UP
SLIDES

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Human Processes, Activities and Behaviors



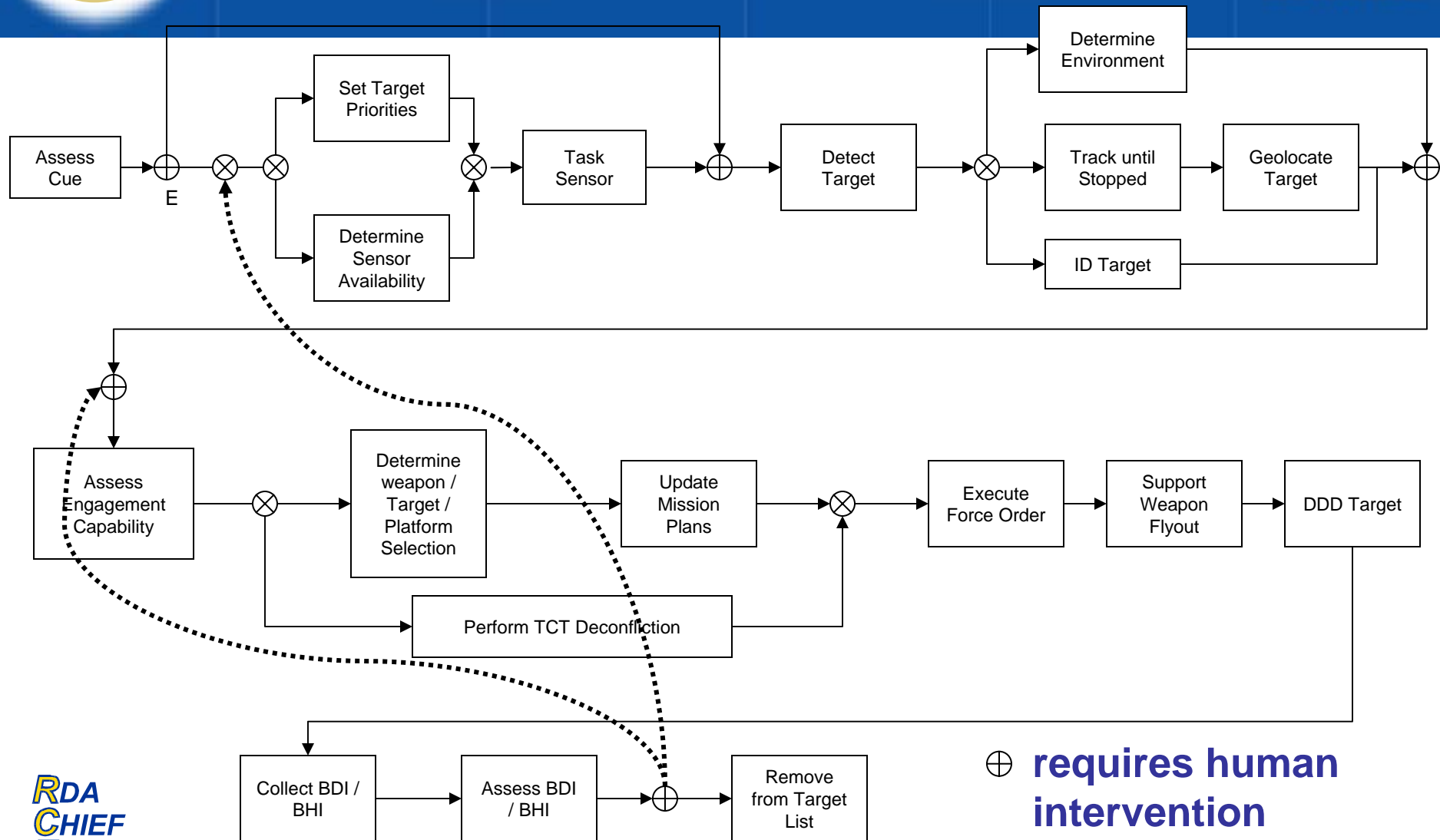
PROCESSES	ACTIVITIES	SPECIFIC BEHAVIORS	DEFINITIONS
1. Perceptual	1.1 Searching For and Receiving Information	1.1.1 Inspects 1.1.2 Observes 1.1.3 Reads 1.1.4 Monitors 1.1.5 Scans 1.1.6 Detects	To examine carefully or to view closely with critical appraisal. To attend visually to the presence or current status of an object, indication, or event. To examine visually information which is presented symbolically. To keep track of over time. To quickly examine displays or other information sources to obtain a general impression. To become aware of the presence or absence of a physical stimulus.
	1.2 Identifying Objects, Actions, Events	1.2.1 Identifies 1.2.2 Locates	To recognize the nature of an object or indication according to implicit or predetermined characteristics. To seek out and determine the site or place of an object.
2. Cognitive	2.1 Information Processing	2.1.1 Interpolates 2.1.2 Verifies 2.1.3 Remembers 2.1.4 Reviews	To determine or estimate intermediate values from two given values. To confirm. To retain information (short-term memory) or to recall information (long-term memory) for consideration. To perceive and comprehend information.
	2.2 Problem Solving and Decision Making	2.2.1 Calculates 2.2.2 Chooses 2.2.3 Compares 2.2.4 Plans 2.2.5 Decides 2.2.6 Diagnoses 2.2.7 Analyzes 2.2.8 Aggregates 2.2.9 Predicts	To determine by mathematical processes. To select after consideration of alternatives. To examine the characteristics or qualities of two or more objects or concepts for the purpose of discovering similarities or differences. To devise or formulate a program of future or contingency activity. To come to a conclusion based on available information. To recognize or determine the nature or cause of a condition by consideration of signs or symptoms or by the execution of appropriate tests. To review and interpret information. To combine information from multiple sources into a composite perspective. To project future outcomes based on current events/information.

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• Excerpted from Handbook of Human Factors, 1987, ed. G. Salvendy (shows 2 of 5 total processes, Motor and Communication not shown)

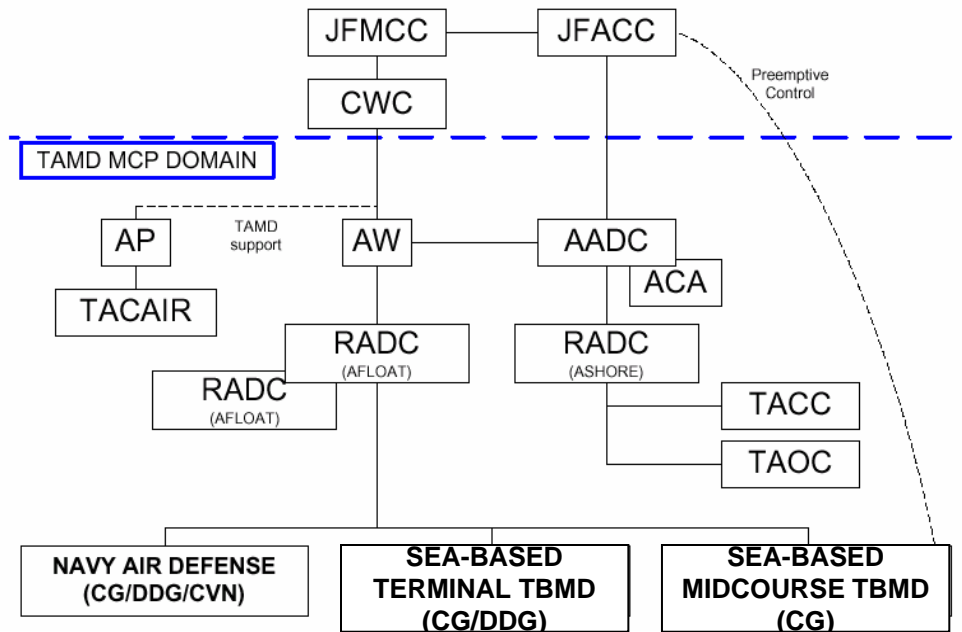


TCT Activity Flow - Kill Chain





OV-4 & Human Roles/Responsibilities Supplement



OV-4 Organizational Relationships Chart

OV-4 Human Roles and Responsibilities

Position	Responsibilities
AADC	Provide theater-wide are defense against ABT and TBM. Coordination between component commanders and task force commander. Design of air defense plan for theater
RADC (Afloat)	Air defense for the region assigned. Coordinate the ADUs for the assigned region.
AW	Air defense for the battleground
TACAIR	Defense counter-air

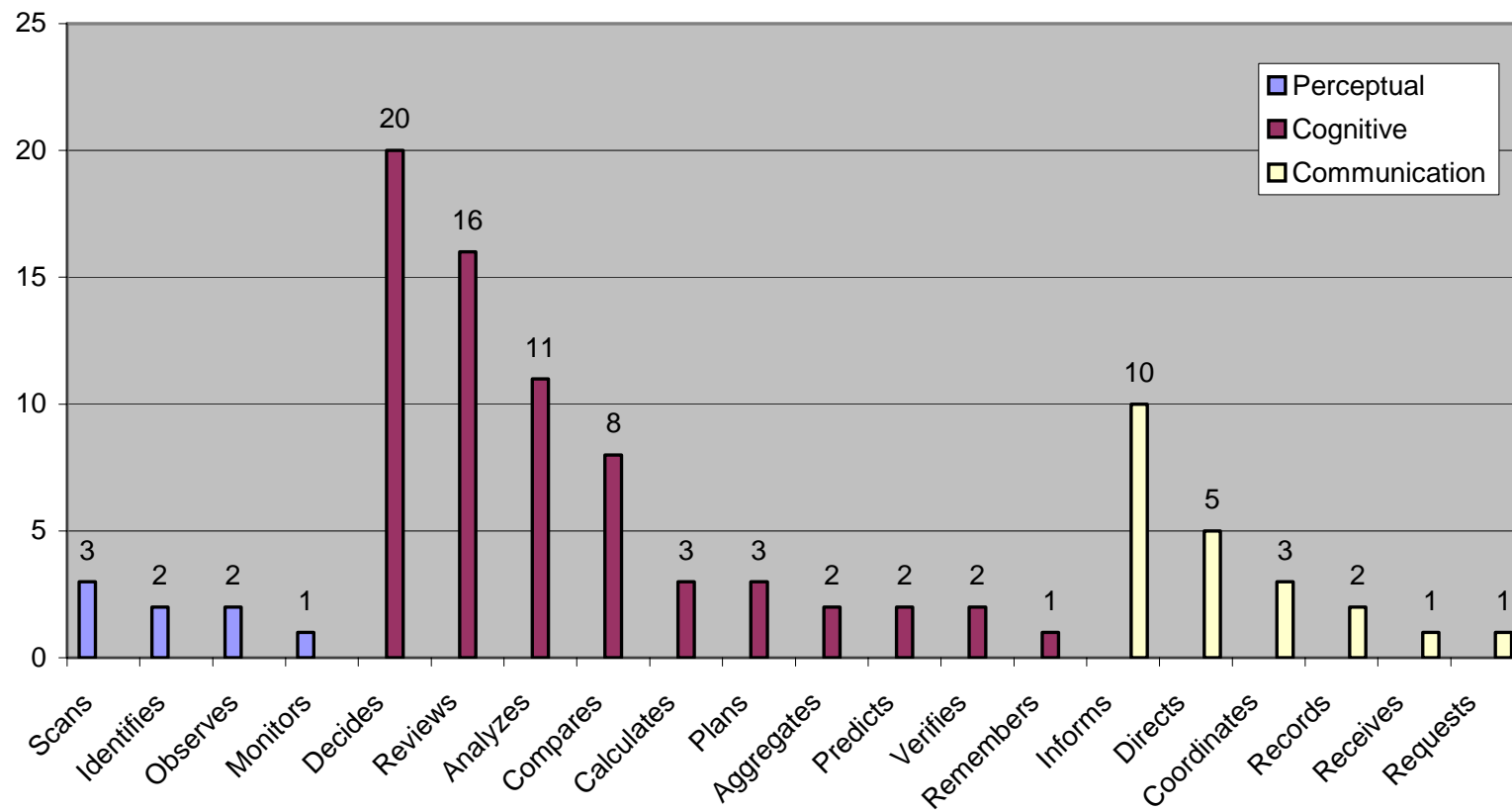
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TCT Kill Chain: Human Behavior Activity Summary



Human Activity Summary



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